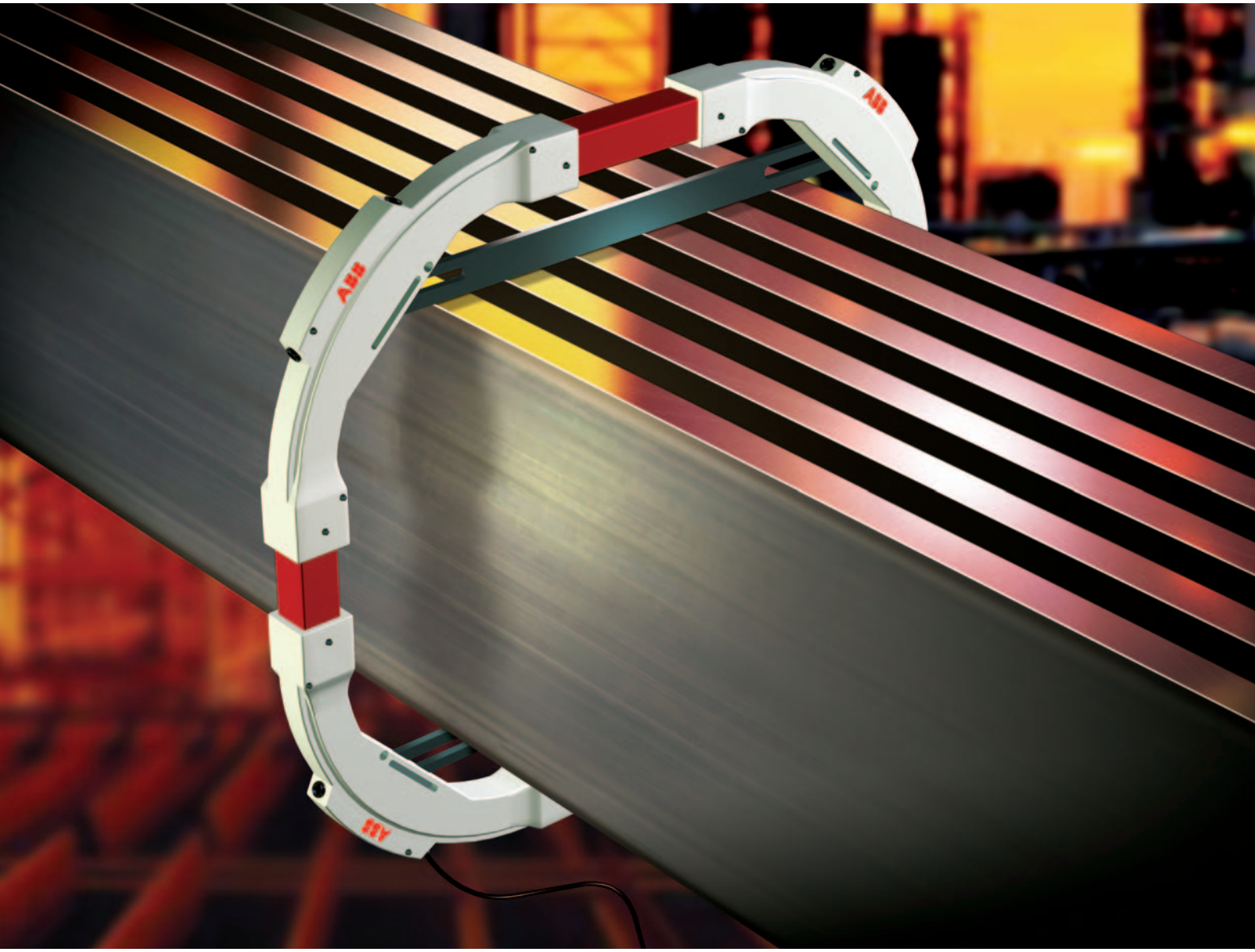
ABB FOCS – Fiber-Optic Current Sensors

Make light work of dc current measurement



Sensor Head

Current knowledge, engineering the future

High current dc measurement systems are a well-established element of process control and regulation in the electro-chemical industry. However, their complexity and the difficulties of commissioning has led ABB to seek an improved solution. The result of our long-term research and development is not just a new approach, but a major advance in applied technology.

ABB has many years of experience in power supply, management and measurement. We also have an unparalleled resource of technical knowledge, and a firm commitment to extensive investment in seeking new solutions and improving existing technology.

As a leading worldwide supplier of state-of-the-art solutions to the electro-chemical industry, we have a unique insight into the requirements of the industry and the problems it encounters, which provides us with a clear advantage in seeking the answers.

Our latest development – the Fiber-Optic Current Sensor – is a perfect demonstration of the leaps in technology which can result from our research.

Tested technology, innovatively applied

Fiber optic technology is proven and well-established. ABB's innovation has been to apply this technology to a current-sensing device, in place of the existing Hall effect solutions.

The results are simplified installation and commissioning, increased accuracy, and a digital signal for greatly enhanced data acquisition, management and negligible power consumption.

Producers of aluminium, copper, manganese and zinc – and other operators of electro-winning and electro chemical processes – will also find numerous additional advantages and benefits of the system.

The science behind the sensor

The new ABB Fiber-Optic Current Sensor is a development of a sensor first used in high-voltage substations. Now available for uni- or bi-directional dc current measurement up to 500kA, with corresponding sensor head sizes, it offers an easily installed, interference-free alternative to the Hall effect current transducers.

Contained within a lightweight, modular housing, the sensing Fiber of the FOCS can be placed in position without the need to open the bus bars. The signal is determined by the enclosed current, independent of any stray magnetic field distribution, and is entirely uninfluenced by any currents outside the optical fiber loop – so the sensor can be placed anywhere along the bus bar without fear of interference.

On-site recalibration after installation is unnecessary, reducing installation time from up to two weeks for a large Hall effect system to just half a day for FOCS.

The Faraday effect

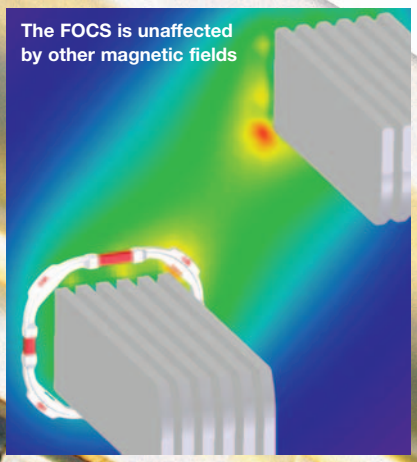
Once in position, the FOCS system utilises the Faraday effect to measure current, with a simple loop of optical fiber around the bus bar, in place of the sophisticated sensor head of conventional transducers.

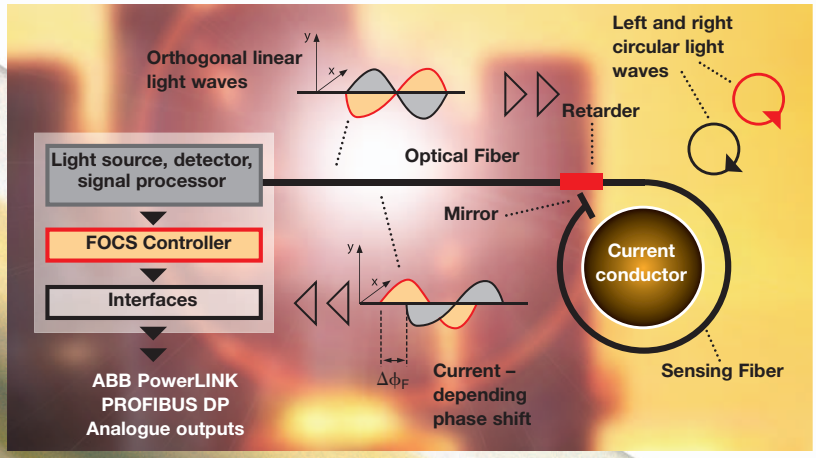
The Faraday effect is the phenomenon of polarised light waves, in a medium such as glass, travelling at different speeds if a magnetic field is applied along the propagation direction. As a result the waves accumulate a phase difference.

Highly accurate

In the FOCS system, right and left circularly polarised light waves travel through the coil of the sensing fiber, are reflected (and their polarisation direction swapped) at the end of the fiber, and then retrace their optical path to the sensor electronics. As the waves travel at different speeds through the sensing fiber if a dc current is flowing, they accumulate a phase difference. This difference is proportional to the line integral of the magnetic field along the sensing fiber, and is therefore a direct and highly accurate measure for the current.

The sensor electronics contain the light source, optical phase detection circuit and digital signal processor. Its technology has been proven in highly demanding applications such as air, land and sea navigation systems. The digital signal processor within the module converts the optical phase difference into a digital signal, which can then easily be transmitted wherever required for analysis.





Choosing the right sensor

The new FOCS system has many advantages over the traditional Hall effect current transducer system. The following questions and answers will show you how the FOCS will best meet your requirements.

How accurate is the system?

Hall effect – Although highly precise, erroneous output may result from, for example, amplifier saturation at local field maxima.

FOCS – Accuracy ± 0.1% from 1 –120% of nominal current. The system is immune to electromagnetic interference, and also requires no magnetic centring. The level of accuracy is unaffected by ambient temperature conditions.

Is an analysis of magnetic field distribution required to assist in selecting and placing the sensor head?

Hall effect – Yes. The traditional current transducer head is susceptible to asymmetric fields and cross-talk from neighbouring currents, so analysis is essential to ensure correct positioning of the head to avoid errors. This can often lead to the selection of a larger system than would normally be necessary.

FOCS – No. The system is immune to electromagnetic interference, and also requires no magnetic centring.

How much does it weigh?

Hall effect – Depending on size, the head can weigh up to 1800kg. There is also an external electronic panel which can weigh up to 320kg and can be up to 1.4m x 1.6m.

FOCS – The sensing head weighs under 15kg. The sensor electronics weigh 5kg, and measure just 150 x 100 x 450mm.

Does the system utilise digital signal processing?

Hall effect – No.

FOCS – Yes. This helps to ensure good long-term stability, and enables digital communication and data acquisition. However, analogue outputs are also available if required.

Is a special structure needed for installation?

Hall effect – Yes. The size and weight of the traditional system requires a dedicated structure.

FOCS – No. The light weight and small size of the FOCS system means it can simply be attached around the bus bar. It can therefore also easily be moved to another location if required.

What is the usual timescale for installation?

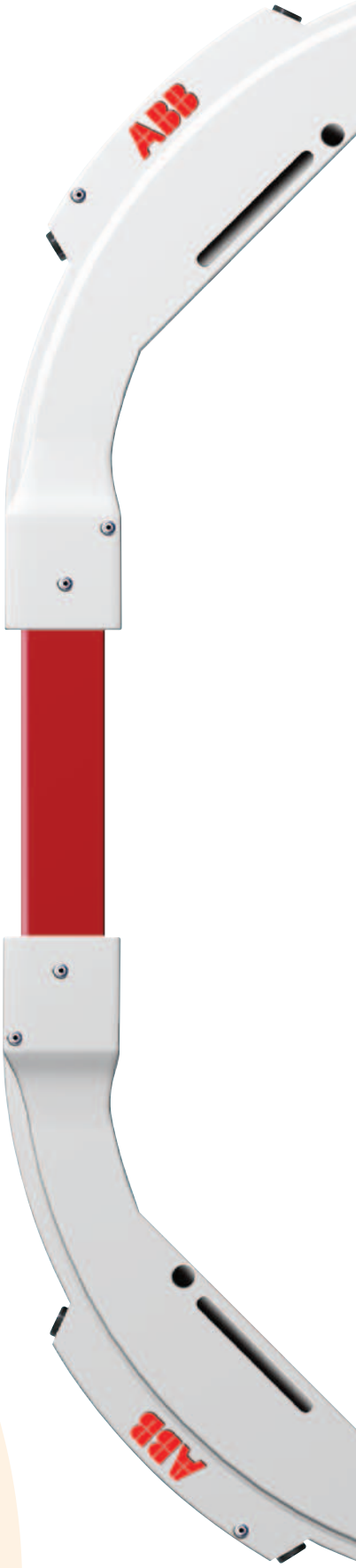
Hall effect – Up to two weeks for a large system.

FOCS – Around half a day.

Is on-site calibration required?

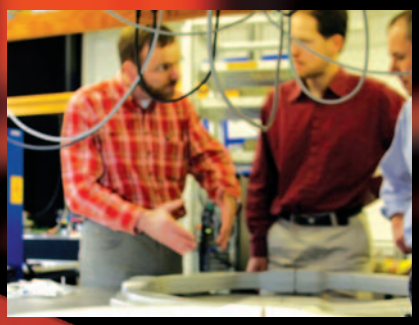
Hall effect – Yes. Calibration is required after installation.

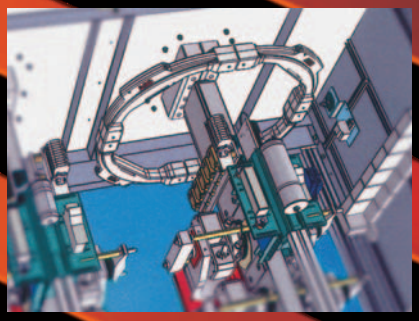
FOCS – No. The FOCS sensor is pre-calibrated at manufacture and there is no need for recalibration during its lifetime.



ABB


ABB





All you need to know

For comprehensive dc current measurement support and advice, or for more information on any aspect of the FOCS system, please contact ABB.

ABB Switzerland Ltd
Fiber-Optic Current Sensors
Dept. ATPR / FOCS
Austrasse
CH-5300 Turgi
Switzerland

Web: www.abb.com/powerelectronics
email: focs@ch.abb.com
Tel: +41 – 58 – 589 39 39
Fax: +41 – 58 – 589 30 00

3BHS208968E01_REV